Testing youth sport climbing performance by cognitive performance versus motor-cognitive tests from Witty SEM system

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Introduction
Several studies explained that sport climbing improves physical fitness, muscle strength, visual-motor coordination, balance, endurance, sensory perception and mobility (Orth et al., 2016). Every new climbing route requires new combination of visual, spatial, kinaesthetic and motor processing (Ginszt et al., 2017).

Witty SEM system is used for specific training for reactivity, agility, coordination skills and motor-cognitive abilities¹. The system has the advantage that the researcher can add the motor aspect in addition to evaluating cognitive skills. The system was used previously in several sports as a training method in car racing (Horváth et al., 2022) but also as an evaluating method in: tennis (Novak et al., 2023), basketball (Horníková et al., 2022), handball (Horníková et al, 2021), soccer (Kaczorowska et al., 2022).

The research question was whether there is any difference between how some cognitive skills measured in laboratory conditions (on computer) influence red-point and on-sight performance and how some cognitive skills measured in a motor task (with Witty SEM) influence red-point and on-sight performance.

Method
We conducted a study on 17 youth advanced climbers including 10 male and 7 female, with ages between 13 and 20 years old (M=16.59; SD=2.09). Climbing experience ranged from 1 to 12 years (M=6.94; SD=2.00). The inclusion criteria were: a minimum of 3 training sessions per week, a minimum of a 7a+ on a red-point lead route climbed in the last year before enrolling into the study (which is considered advanced by IRCRA scale (Draper et al., 2016)) and at least one participation in one national competition in the last year before enrolling into the study. Because we evaluated some cognitive variables, we assessed also school background.

The study examined cognitive variables (spatial orientation and reactivity - with Cognitrom battery) and motor-cognitive variables (cognitive agility measured by red A test, visual processing speed measured by hawk eye test, visual memory measured with eye for detail test - with Witty SEM system¹¹). The output of every test was assessed with time for realising the task and number of errors. Two examples of the motor-cognitive tests can be seen in the figures below (Figure 1, Figure 2).

We used Witty’s 10 tripods and defined a setting that resembled the start-up position from a climbing boulder: with 4 starting points (2 for hands and 2 for feet) and 6 more tripods that resembled possible future holds that the climber had to touch.

We used regression analysis for predicting performance and moderation analysis for analysing the influence of school background on the relationship between motor-cognitive variables and performance.

Results
From the correlation analysis, we concluded that visual processing speed (measured with hawk eye test) did not influence climbing performance. Reactivity variables did not influence climbing performance.

We conducted 4 regression analyses to examine the influence of cognitive variables on performance in comparison with the influence of the motor-cognitive variables on performance.

Experience and number of errors at the eye for detail task influence on-sight performance variance in 81.3% of the cases. Greater number of errors was associated with lower on-sight performance. When analyzing red-point performance, the prediction raised from 21.7% based on spatial orientation to 52.1% based on visual memory errors and cognitive agility.
Thus, the prediction of red-point performance based on motor-cognitive variables is higher than only on cognitive variables. School background influenced the relation between: visual memory errors and on-sight performance.

**Discussion**
This is the first study that used Witty SEM as an evaluating method for climbing performance, using red A test and eye for detail test, but not hawk eye test. We defined a specific set up for the semaphors of the Witty system for evaluating youth advanced climbers. We demonstrated that cognitive skills measured in a motor task (cognitive agility, visual memory) can predict better climbing performance than cognitive skills in general (spatial orientation).
The influence of school background explained that the lower a climber's educational level is, the more their tendency to make mistakes in the motor-cognitive test will negatively influence their on-sight performance.

**References**

**Short Biography**
The presenting author is a second year resident neurologist and also a third year PhD student at National University of Physical Education and Sport in Bucharest, Romania. She has two masters: one in sport performance and one in health psychology. She was a professional sport climber in my country, having multiple National Champion titles in bouldering and lead. Her field of study is cognition. She is passionate about ways of improving cognition in sports that can lead to better performance. For contacting her, please use the following email address: antoniaioana97.vasile@gmail.com.